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BOOKS IN REVIEW

TRACERS IN THE OCEAN

Edited by H. CHARNOCK; J.E. LOVELOCK; P.S. LISS and M. WHITFIELD,
London, The Royal Society (1988), 236 p.

As oceanographers enter the last decade of the 20th century, they must confront challenges which could not have been foreseen by their peers only two decades ago. The oceans play a central role in a very complex interplay of physical, chemical and biological processes which, through modulation of the world's climate may, or may not, save mankind from some of the unexpected and onerous consequences of his contamination of the earth's atmosphere. In order to respond to this challenge, precise information is required on the dynamics of ocean/atmosphere interactions, the role of the deep ocean, the dynamics of oceanic mixing processes and the kinetics of physical, geochemical and biological mobilization of critical 'contaminants' such as carbon dioxide. One way to obtain such information is to measure and model the dynamics and distribution of transient chemical tracers in the ocean such as natural and artificial radionuclides, trace elements, traces of organic materials and plant nutrients.

All this is clearly a complex business and *Tracers in the Ocean* does not pretend to be a beginner's text. The book is a collection of 14 papers written by experts in a wide variety of fields ranging from trace element and radionuclide geochemistry, through ocean/atmosphere exchange, to physical (eclectic) modelling (to deduce general circulation). The collection (based on the proceedings of a Royal Society Discussion Meeting held on 21-22 May 1987) is very well-balanced and enriched by useful (and often incisive) comments which clearly illustrate the controversial nature of some of the papers. As one would expect from the Royal Society, the quality of the edition is excellent and in no way resembles the many collections of disorderly conference papers 'cobbled together' as books which presently flood the market.

Connoisseurs will find this book a fascinating follow-up to BROECKER and PENG's (1982) *Tracers in the Sea* (note the unfortunate synonym), a book which has caused a major impression within the oceanographic community and which would be good introductory reading to the present text. Though some papers present major innovations in the use of chemical tracers (the paper on rare earth elements by ELDERFIELD is particularly excellent), the major emphasis is on data modelling and it is here where controversy is at its greatest. The obvious differ-

ences of opinion between several of the workers regarding the relative merits of their multiple box models and inverse methods could lead the reader to despondency. BIGG and KILLWORTH add fuel to the fire with the statement that 'One of the biggest problems with the use of inverse methods to infer the ocean circulation is to estimate how well they capture the *desired flow*'. One is reminded of the PhD student who concluded that 'the data appears to fit the facts'. WUNCH, in the final paper in this book, leads us through the wilderness of two-dimensional models which don't 'fit the facts' to a three dimensional one which clearly does and demonstrates the potential of transient chemical tracers and inverse modelling as major tools for the future of oceanography. Furthermore, several of the papers in this book show that deep ocean ventilation (and ocean-atmosphere coupling) may be a much more dynamic process than we had first imagined and that, unless we urgently improve our quantitative knowledge in this field, we will not be able to accurately predict climatic changes produced by the impact of man on his environment. Fortunately, this book makes a worthy contribution to this vitally important issue.

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Reference: BROECKER, W.S. and PENG, T.-H. (1982): *Tracers in the Sea,* Eldigio Press, Palisades, New York, USA, 634 p.